ILLICIT DISCHARGE INDICATOR THRESHOLDS MEMORANDUM

Prepared for
Washington State Department of Ecology

Prepared by
Herrera Environmental Consultants, Inc.

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TABLES

Background

The Illicit Connection and Illicit Discharge Field Screening and Source Tracing Guidance Manual (Manual) was developed to serve as guidance for municipalities in Washington that perform field screening and source tracing to address illicit discharge detection and elimination (IDDE) program requirements in the National Pollutant Discharge Elimination System (NPDES) Phase I and Phase II Municipal Stormwater Permits.

The manual was developed by King County, the Washington Stormwater Center, and Herrera Environmental Consultants (Herrera) using funding from a Grant of Regional or Statewide Significance (Grant No. G1200467) from the Washington State Department of Ecology. During the development of the manual, a survey of Washington permittees (IDDE field screening survey) was conducted to determine which methodologies and indicators were being used in 2012 for field screening and source tracing of illicit discharges.

A total of 35 Eastern Washington and Western Washington Phase I and Phase II jurisdictions responded to the IDDE field screening survey. A literature review was also performed to gather input from national IDDE programs as well as Washington State IDDE programs. A total of 25 local and national references were reviewed during this process. Indicator thresholds were selected based on a combination of the IDDE field screening survey results, the literature review, and the professional judgment of the grant team. This supplemental memorandum describes the evaluation and consideration process used to develop the indicator thresholds that are included in the manual.

The final manual and a report that summarizes the results of the survey and literature review can be accessed via the following link on the Washington Stormwater Center's website: http://www.wastormwatercenter.org/illicit-connection-illicit-discharge.

Primary Field Screening Indicator Thresholds

Table 1 summarizes the primary field screening indicator threshold ranges from the IDDE field screening survey and literature review, describes the evaluation process and considerations for application of these thresholds for use in Washington, and presents final indicator thresholds that were included in the manual. Color, odor, and visual indicator thresholds are not included in Table 1 since they were fairly consistent among local jurisdictions and in the literature review to be the following:

- **Color**: Any discoloration not attributed to natural phenomena
- **Odor**: Any odor
- **Visual indicators**: Abnormal vegetation, deposits and staining, fish kills, floatables, fungus and algae, structural damage, surface scum, surface sheen, trash and debris

Table 1. Primary Field Screening Indicator Thresholds.

Primary Field Screening Indicator	Range Used in Washington [a]	Range in Literature Review [a]	Evaluation/Considerations	Final Threshold [b]
pH	Low end of range: < 4 to < 6.6	Low end of range: <3 to <6.5	<5 was selected for the low end of the pH range based on the values currently used in the state and found in the literature review; some flexibility was incorporated so that the threshold was not too low (<3 or <4), but not as high as the state water quality standard (<6.5) [c]	<5 or >9
	High end of range: >8.5 to >11	High end of range: >8.5 to >12	>9 was selected for the high end of the pH range based on the values currently used in the state and found in the literature review; not too high (>11 or >12), but higher than the state water quality standard (>8.5) [c]	
Turbidity	>25 to > 200 NTU	>100 to >1,000 NTU	• 1,000 NTU seemed too high for a field screening threshold for turbidity • 50 NTU is consistent with what can be considered to be visible, cloudy, or opaque using visual observations	>50 NTU
Ammonia	>0.1 to > 5mg/L	≥ 1.0 to >50 mg/L	• 0.1 mg/L seemed too low for a field screening threshold for ammonia and 50 mg/L seemed too high • >1.0 mg/L is currently used by Kitsap County and King County and was selected for this manual	>1.0 mg/L
Temperature	>20 to 30 degrees Celsius or above ambient air temperature	>26.7 to 30 degrees Celsius, above ambient air temperature, warm, unusual/abnormal	• Selecting an exact value for temperature seemed arbitrary, since it does not take into account the time of year or natural fluctuations • Above ambient air temperature is easy to measure and is already being used by several local jurisdictions (Snohomish County, City of SeaTac, and King County)	Above ambient air temperature

[a] Source: Herrera (2012)
[b] Source: Herrera (2013)
[c] Source: Surface Water Quality Standards, Chapter 173-201A WAC
NTU = Nephelometric Turbidity Units
mg/L = milligrams per liter

Follow-up Indicator Thresholds

Table 2 summarizes the follow-up indicator threshold ranges from the IDDE field screening survey and literature review, describes the evaluation process and considerations for application of these thresholds for use in Washington, and presents the final indicator thresholds that were included in the manual.

Table 2. Follow-up Indicator Thresholds.				
Follow-up Indicator	**Range Used in Washington [a]**	**Range in Literature Review [a]**	**Evaluation/Considerations**	**Final Threshold**
Detergents/ Surfactants	>0.25 to > 1mg/L	>0.25 to >25 mg/L	• >25 mg/L seemed too high for an illicit discharge investigation • >0.25 mg/L is consistent with standard test kit measurements and is currently used by several local jurisdictions (City of Issaquah, Clark County, and King County)	>0.25 mg/L
Chlorine or Fluoride	>0.01 to >0.6 mg/L for chlorine	>0.2 to >0.5 mg/L for chlorine	>0.3 mg/L is used by the City of Seattle and King County as an illicit discharge investigation threshold for fluoride and was a good value in the middle of the range that could also work for chlorine	>0.3 mg/L
	>0.25 to >1 mg/L for fluoride	>0.25 to >0.6 mg/L for fluoride (some used >1.0 for commercial/industrial)		
Ammonia/ Potassium ratio	>1	>1	1 is consistently included in the literature as the accepted ratio to distinguish between a wastewater source (>1) and a washwater source (<1)	>1
Hardness	Low end of range: <10 or <200 mg/L as $CaCO_3$	Low end of range: <10 mg/L as $CaCO_3$	≤10 mg/L as $CaCO_3$ was commonly used for the low end of the hardness range based on the survey and the literature review	≤10 or ≥1,000 mg/L as $CaCO_3$
	High end of range: >500 or >2,000 mg/L as $CaCO_3$	High end of range: >500 to >2,000 mg/L as $CaCO_3$	≥1,000 mg/L as $CaCO_3$ was a good option in the middle of the range used by King County and Snohomish County and is currently used by Kitsap County	
Fecal Coliform Bacteria	>200 to >5,000 CFU/100 mL	>400 to >5,000 CFU/100 mL	• >5,000 CFU/100 mL is used as an illicit discharge investigation threshold by the City of Seattle, King County, and Snohomish County, but is high for dry weather screening • The manual includes thresholds for dry weather and wet weather screening. The use of a higher indicator threshold during wet weather accounts for common inputs of animal sources from stormwater runoff and reduces the potential for false positive indication of sewage contamination.	Dry weather: >500 CFU/100 mL Wet weather: >5,000 CFU/ 100 mL

Table 2 (continued). Follow-up Indicator Thresholds.				
Follow-up Indicator	**Range Used in Washington [a]**	**Range in Literature Review [a]**	**Evaluation/Considerations**	**Final Threshold**
Specific Conductivity	>500 to >1,000 µS/cm	>400 to >2,000 µS/cm	Specific conductivity is only recommended for use in commercial/industrial land use settings, therefore the higher value used in the Center for Watershed Protection Manual (CWP 2004) was selected.	>2,000 µS/cm
Nitrate	>1 to >3 mg/L	>1 mg/L	>1 mg/L is used by King County and North Texas and >3 mg/L is used by Kitsap County. Since >1 mg/L was used in two of the three references reviewed, the lower threshold was selected for the manual.	>1 mg/L

[a] Source: Herrera (2012)
mg/L = milligrams per liter
$CaCO_3$ = calcium carbonate
CFU/100 mL = Colony Forming Units per 100 milliliters
µS/cm = micro-siemens per centimeter

Other Indicators

The following indicators summarized in Table 3 are not described in detail in the manual, but may be used for specialized investigations on a case-by-case basis. Threshold values (or ranges) are included if they were specified in the references reviewed for the literature review for this project, but were not available for all indicators. A number of indicators are included in this table without threshold values because no values were provided by the literature review. These indicators have been included because of their value in special investigations and if used the investigators will need to develop appropriate threshold values.

Table 3. Other Indicator Thresholds.

Other Indicators	Description	Threshold Value
Alkalinity	Alkalinity is a measure of the buffering capacity (ability to neutralize acids and bases) of a water body. It can be used along with pH, hardness, temperature, and conductivity, as an indicator of an industrial wash water discharge.	NG
Bacteroides	*Bacteroides* are obligate anaerobic bacteria that comprise a majority of microorganisms in the human digestive tract. Laboratory methods for *Bacteroides* are currently being developed and refined.	Under development; contact King County Environmental Lab Microbiology Unit to discuss
Biochemical oxygen demand (BOD)	BOD is a measure of the amount of oxygen required or consumed for the microbiological decomposition (oxidation) of organic material in water. High BOD values may indicate industrial, domestic, or agricultural sources of organic matter, which may cause low dissolved oxygen levels.	NG
Boron	Boron is added as a water softener to washing powders and detergents and may indicate sewage or washwater discharges.	>0.35 mg/L for wastewater or washwater [a,b,c] <0.35 mg/L for tap or irrigation water [b,c]
Dissolved oxygen	Dissolved oxygen is an important parameter for salmonids and other aquatic organisms. Low dissolved oxygen levels can be harmful to larval life stages and respiration of juveniles and adults.	<6 mg/L [d]
E. coli bacteria	*E. coli* bacteria are types of fecal coliform bacteria commonly found in the intestines of animals and humans. *E. coli* can either be analyzed at an analytical laboratory or in an office setting using a Coliscan Easygel test, A Coliscan Easygel test is a useful tool for screening for bacteria loads. The Coliscan Easygel test requires the following equipment: a freezer, a small Styrofoam chicken egg incubator, a field pipette, disposable pipette tips, nutrient broth bottles, Petri dishes pre-treated with agar.	>394 CFU/ 100mL [d] >5,000 CFU/ 100 mL [c]
Enterococcus bacteria	Enterococci are a subgroup of the fecal streptococci. Fecal streptococci indicate the presence of fecal contamination by warm-blooded animals and are not known to multiply in the environment like fecal coliform bacteria.	>5,000 MPN/ 100 mL [a]

Table 3 (continued). Other Indicator Thresholds.		
Other Indicators	**Description**	**Threshold Value**
Glycol	Glycol or ethylene glycol is the main component of automotive antifreeze.	>0.5 mg/L [e] >1.5 mg/L [f] >5 mg/L [d]
Metals	Metals are inorganic substances that occur naturally. Typical metals measured as water quality parameters include copper, lead, and zinc. At higher concentrations copper can become toxic to aquatic life. At low concentrations, copper can negatively affect olfaction in salmonids that plays a key role in species recognition, migration, reproduction, and predator avoidance.	>0.025 mg/L (copper) g >0.1 mg/L (copper) h >0.1 mg/L (lead) e >0.2 mg/L (nickel) e
Phenol	Phenols are organic compounds that are produced for various industrial processes. Phenols are can be toxic to both humans and aquatic organisms.	>0.1 mg/L g >1.0 mg/L h
Phosphate	Phosphate (or phosphorus) is a concern in fresh water because high levels can lead to accelerated plant growth, algal blooms, low dissolved oxygen, decreases in aquatic diversity, and eutrophication.	>0.5 mg/L e >1.5 mg/L d ≥5.0 mg/L f
Orthophosphate	Orthophosphate (also known as soluble reactive phosphorus or SRP) is an inorganic fraction of phosphorus that is produced by natural processes, but also can be measured in municipal sewage. Additional sources of orthophosphate are similar to those for phosphate such as septic system failure, animal waste, decaying vegetation and animals, and fertilizer runoff.	NG
Semi-volatile organic compounds (SVOCs)	SVOCs are used and produced in the manufacturing industry (for example, in plastic, pharmaceutical and pesticide manufacturing)	NG
Tannins and lignins	Tannins and lignins are released during the decomposition of wood and tend to make water look dark brown or tea-colored.	NG
Total petroleum hydrocarbons (TPH)	TPH is a term used to describe a large family of several hundred chemical compounds that originally come from crude oil.	NG
Toxicity screening tests	Toxicity screening tests are short-term tests performed in a laboratory to assess the relative toxicity of a water sample to a selected test organism.	NG

[a] Source: Center for Watershed Protection (2004)
[b] Source: Lower Charles River (2004)
[c] Source: Snohomish County (2010)
[d] Source: King County (2011)
[e] Source: North Central Texas (2011)
[f] Source: Kitsap County (2011)
[g] Source: Lake County (2009)
[h] Source: Wayne County (1996)
CFU/100mL = colony forming units per 100 milliliters
mg/L = milligrams per liter
MPN/100 mL = most probable number per 100 milliliters
NG = no guidance provided in literature review

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